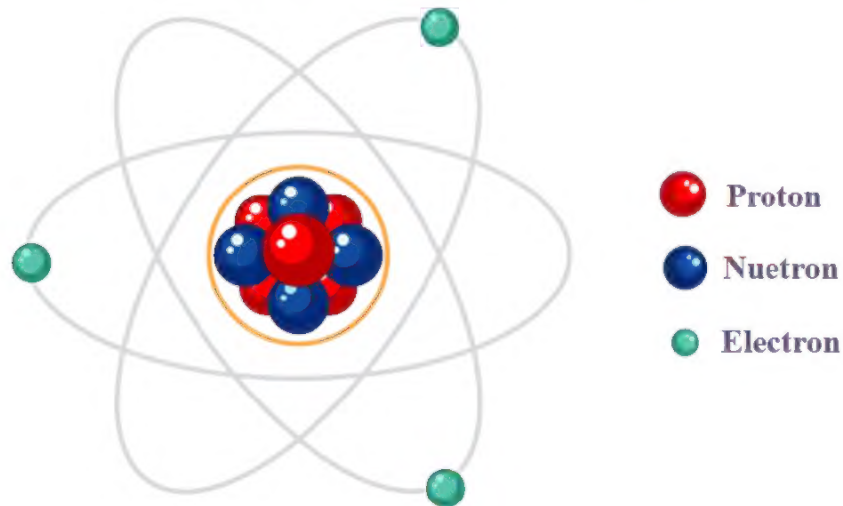


Atom and human body

Structure of Atom



Index:

- What is an atom?
- Atom in the human body
- Elements of atom in the human body
- Nuclear medicine: its definition and uses in diagnosis and treatment

What is Atom ?

An atom is the fundamental building block of matter and the smallest particle of a chemical element that retains its properties. It consists of a central nucleus, made of positively charged protons and neutral neutrons, surrounded by negatively charged electrons. The number of protons, called the atomic number, defines the element.

- Components of an Atom:

1. Protons: Positively charged particles found in the nucleus.
2. Neutrons: Particles with no electrical charge, also found in the nucleus.
3. Electrons: Negatively charged particles that orbit the nucleus.

- Key Characteristics

*** Building Block:**

Atoms are the basic units that make up all matter and form molecules when they bond together.

*** Atomic Number:**

The number of protons in an atom's nucleus determines which chemical element it is.

* Isotopes:

Atoms of the same element can have different numbers of neutrons; these variations are called isotopes.

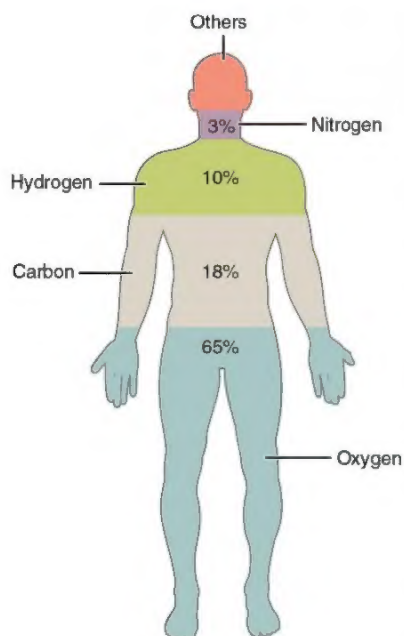
* Ions:

When an atom gains or loses electrons, it develops an electrical charge and is known as an ion.

* Too Small to See:

Atoms are subatomic, meaning they are far too small to be seen with a standard microscope.

Atom in the human body ?



Element	Symbol	Percentage in Body
Oxygen	O	65.0
Carbon	C	18.5
Hydrogen	H	9.5
Nitrogen	N	3.2
Calcium	Ca	1.5
Phosphorus	P	1.0
Potassium	K	0.4
Sulfur	S	0.3
Sodium	Na	0.2
Chlorine	Cl	0.2
Magnesium	Mg	0.1
Trace elements include boron (B), chromium (Cr), cobalt (Co), copper (Cu), fluorine (F), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se), silicon (Si), tin (Sn), vanadium (V), and zinc (Zn).		less than 1.0

The human body contains approximately 7 octillion (7×10^{27}) atoms, which are primarily composed of the elements oxygen, carbon, hydrogen, and nitrogen. Other key elements include calcium, phosphorus, potassium, and sulfur, as well as trace amounts of numerous other chemical elements. These atoms are organized into molecules, cells, and the overall structures of the body, with the proportion of each atom varying based on individual factors like age, diet, and genetics.

- Major Elements:

The vast majority of atoms in the human body are from just four elements:

- 1. Oxygen (O):** The most abundant element, making up about 65% of the body's mass.
- 2. Carbon (C):** Forms the backbone of all organic molecules and is essential for life.
- 3. Hydrogen (H):** The simplest and most abundant element in the universe.
- 4. Nitrogen (N):** A key component of proteins and nucleic acids.

- Other Important Elements:

In addition to the top four, other elements are vital for bodily functions:

Calcium (Ca), Phosphorus (P), Potassium (K), Sulfur (S), Sodium (Na), Chlorine (Cl), and Magnesium (Mg).

- Atomic Composition:

*** Total Number:** The average 70 kg adult human body contains about 7×10^{27} atoms.

*** Organization:** Atoms are not randomly distributed but are organized into molecules that perform specific biological functions.

*** Variability:** The exact number and type of atoms, especially trace elements, can vary between individuals due to factors such as age, diet, and environmental influences.

- Nuclear medicine:

Nuclear medicine is a medical specialty that uses small amounts of radioactive substances, called radiopharmaceuticals, to diagnose, treat, and monitor diseases by visualizing how organs and tissues function. Unlike standard imaging like X-rays, which show the body's structure, nuclear medicine scans provide functional information by

tracking the path of the radioactive tracer from inside the body using specialized cameras like SPECT and PET.

- How it Works:

*** Radiopharmaceuticals:**

A radioactive substance is attached to a drug to create a radiopharmaceutical, which is designed to target a specific organ or tissue.

*** Administration:**

The radiopharmaceutical is typically injected into a vein or, in some cases, taken orally or inhaled.

*** Imaging:**

After a short waiting period, a special camera, such as a SPECT or PET scanner, captures the radiation emitted from the radiotracer within the body.

*** Information:**

These images reveal how the targeted organ or tissue is working, providing insights into its metabolic activity and physiological function.

- Applications:

Nuclear medicine is used for both diagnosis and treatment.

*** Diagnosis:**

It helps doctors diagnose conditions like tumors, infections, and heart or brain problems by assessing organ function and blood circulation.

*** Treatment:**

In some cases, the radioactive materials are used to target and destroy damaged or diseased cells and tissues.

*** Theranostics:**

This branch combines diagnostic imaging with targeted radionuclide therapy, where a diagnostic radiopharmaceutical identifies a molecular feature of a disease, allowing for the selection of patients for subsequent targeted therapy.

- Key Differentiator:

A primary distinction from other imaging methods is that nuclear medicine shows function rather than structure. While an X-ray shows what the inside of your body looks like, a nuclear medicine scan shows how your organs are performing.

- Nuclear medicine frequencies:

Nuclear medicine primarily uses gamma-rays and annihilation radiation for diagnosis, not radio frequencies, which are a form of non-ionizing radiation. The specific gamma-ray energies, typically in the 80-350 keV range, are chosen based on the radionuclide used, with Technetium-99m (Tc-99m) being the most common due to its 140 keV gamma-ray energy and 6-hour half-life.

- Types of Radiation Used:

*** Gamma-rays:**

These are emitted from the nucleus of an unstable atom as it transitions to a more stable state.

*** Annihilation Radiation:**

In Positron Emission Tomography (PET), positrons emitted by a radionuclide annihilate with electrons, producing two gamma-rays with a specific energy of 511 keV.

- Common Radionuclides and Their Energies:

*** Technetium-99m (Tc-99m):** The most widely used radionuclide, producing a 140 keV gamma-ray.

*** Fluorine-18 (18F):** Often used in PET imaging, it is

a positron-emitting radionuclide.

*** Iodine-123 (I-123):** Used for brain and thyroid imaging, with a different energy than Tc-99m.

- How the "Frequency" is Applied:

*** Radioisotopes and Energy Levels:**

Each radioisotope has characteristic emission energies, which are measured by the diagnostic equipment.

*** Pulse-Height Spectrum:**

Detectors record the energy of the incoming radiation, creating a pulse-height or energy spectrum where the different energy peaks identify the radionuclide being used.

*** Clinical Choice:**

The choice of radioisotope depends on the specific organ or disease being studied.

More Related articles

- Signal Jamming:

<https://archive.org/details/signal-jamming>

- Medical Device:

<https://archive.org/details/medical-device-wikipedia/>

- الأغذية المعلبة :

https://archive.org/details/canned_foods

- صحة الانسان الفيتامينات و المعادن :

https://archive.org/details/human_health_care_v_m

- Gamma ray:

https://en.m.wikipedia.org/wiki/Gamma_ray

- Ultrasound Applications:

<https://archive.org/details/ultrasound-applications>

- CMOS Sensor What is & how it works?

<https://archive.org/details/cmos-sensor-what-is>

- Microelectronics FROM RESEARCH TO INDUSTRY:

https://archive.org/details/microelectronics_industry

- Visible Spectrum:

<https://archive.org/details/visible-spectrum>

- Hearing Range:

<https://archive.org/details/hearing-range-wikipedia>

- Microwave:

<https://archive.org/details/microwave-wikipedia/>

- Radio Spectrum:

<https://archive.org/details/radio-spectrum-wikipedia>

- Artificial Intelligence In Healthcare:

<https://archive.org/details/artificial-intelligence-in-healthcare-wikipedia/>

By: Haytham Zeidan

<https://archive.org/details/@wazefapress>

07.09.2025

Resources:

<https://www.nibib.nih.gov/science-education/science-topics/nuclear-medicine>

<https://www.iaea.org/sites/default/files/nuclear-medicine-for-diagnosis-and-treatment.pdf>

<https://www.cdc.gov/radiation-health/data-research/facts-stats/nuclear-medicine.html>